The role of sleeping abnormalities on the driving performance of individuals with Mild Cognitive Impairment

I. N. Beratis[1], N. Andronas[1] , E. Papadimitriou[2], D. Kontaxopoulou[1], S. Fragkiadaki[1], C. Koros[1], A.Bonakis[1], A. Economou[3], S. G. Papageorgiou[1]

[1] 2nd Department of Neurology, "Attikon" University General Hospital, University of Athens, [2]National Technical University of Athens, School of Civil Engineering, Department of Transportation Planning and Engineering [3]Department of Psychology, University of Athens, Athens, Greece

1ST CONGRESS OF THE EUROPEAN ACADEMY OF NEUROLOGY

Berlin, Germany, June 20-23 2015

ABSTRACT

Objectives: Goal of the present study was to explore the role of sleeping abnormalities on the driving behavior of individuals with MCI. **Methods:** Twenty seven cognitively intact individuals (Age: 63.4±7.2 years) and 33 individuals with MCI (Age: 66.4±7.4 years) were included in the analysis. A CDR score of 0.5 was required for the diagnosis of MCI. The Athens Insomnia Scale (AIS) and the Epworth Sleepiness Scale (ESS) were applied for the assessment of sleeping abnormalities. Outcome measures were average speed, lateral position, lateral position variation, average headway distance, wheel average position and reaction time in unexpected incidents. **Results:** The analysis did not reveal significant correlations between sleeping abnormalities and indexes of driving performance in the cognitively intact group. In the drivers with MCI the analysis revealed significant correlations between sleeping abnormalities and: (a) lateral position variation (AIS: r=-.502, p=.003; ESS: r=.355, p=.042), (b) average speed (ESS: r=.345, p=.049), (c) average headway distance (ESS: r=-.373, p=.032), (d) wheel average position (AIS: r=-.374, p=.032). **Conclusions:** Sleeping abnormalities appear to play role on driving indexes that could influence the driving behavior of individuals with MCI.

INTRODUCTION

- **MCI population appears to be at risk for driving difficulties, although their performance on on-road or on simulator testing is not consistently worse than that of controls (Fritteli et al., 2009; Kawano et al., 2012; Wadley et al., 2009)**
- **Measures of mental flexibility, inhibitory control and visual attention appear to be associated with driving performance in patients with MCI, but this issue needs further investigation (Kawano et al., 2012)**
- **Insomnia symptoms and drowsiness appear to reduce the driving capacity of older drivers (Vaz Fragoso et al., 2008; Vaz Fragoso et al., 2013)**
- **Sleep disturbances appear to be one of the core non cognitive symptoms of individuals with MCI (Beaulieu-Bonneau S & Hudon, 2009).**

OBJECTIVES

Goal of the present study was to explore for the first time the role of sleeping abnormalities on the driving performance of individuals with MCI as well as to compare their pattern of findings with that of cognitively intact individuals.

PATIENTS & METHODS

- **A CDR (Clinical Dementia Rating) score of 0.5 was required for the diagnosis of MCI. Additional inclusion criteria were the presence of a valid driver's license and regular car driving**
- **Twenty seven cognitively intact individuals (Age: 63.4±7.2 years) and 33 individuals with MCI (Age: 66.4±7.4 years) were included in the analysis. The collection of the data included: (a) a clinical medical and neurological assessment, (b) extensive neuropsychological assessment that included two different sessions taking place in different days(≈2 month interval), and (c) a driving simulation experiment**
- **The Athens Insomnia Scale (AIS) and the Epworth Sleepiness Scale (ESS) were applied for the assessment of sleeping patterns.**
- **Outcome measures were average speed (km/h), average lateral position (average vehicle distance from the central road axis in meters), lateral position variation (the standard deviation of lateral position), average headway distance (average distance from other vehicles in meters), wheel average position (wheel steering angle in degrees) and reaction time in unexpected incidents (in milliseconds).**
- **Driving was assessed with a Foerst FPF driving simulator, in different conditions**

I. **Phase 1: Practice session (5-10 min.)**

II. **Phase 2: Driving session: driving on a two-lane rural road for 20 min. The sudden appearance of animals on the rural road played the role of unexpected incidents during the driving assessment**

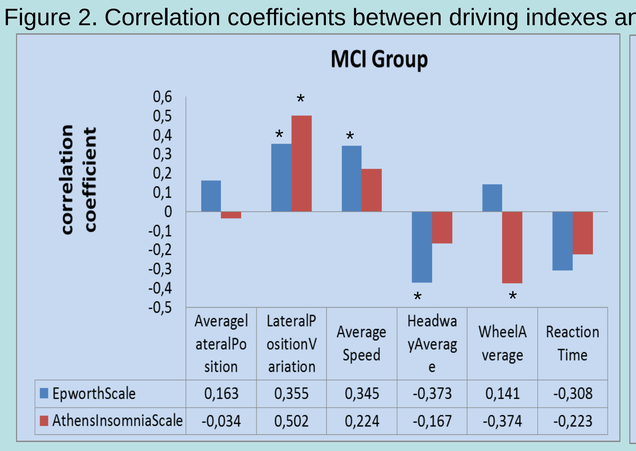
Figure. 1 Driving under the rural Condition

RESULTS

Table.1 Control vs. MCI Group on Cognitive, Sleep Behavior, & Driving Indexes

	Control Group		MCI Group		t-test	
	Mean	SD	Mean	SD	t	p
MMSE	29.22	.93	27.94	1.95	3.13	.003
Trails A	45.33	13.65	61.03	40.63	2.08	.044
Trails B	89.48	42.71	149.61	82.79	3.62	.001
HopkinsTotal	23.30	4.40	18.03	5.11	4.21	<.001
HopkinsDelayed	7.41	2.89	3.94	4.33	3.70	<.001
Epworth Scale	5.23	4.04	5.97	2.98	.78	.440
Athens Insomnia Scale	3.19	2.99	4.21	3.72	1.14	.261
Average Speed	42.06	8.26	39.69	7.42	1.17	.247
Wheel Average	-1.79	0.59	1.83	0.45	.30	.764
Average Headway Distance	475.73	129.50	516.87	139.78	1.17	.246
Reaction Time	1705.38	538.31	2072.66	760.09	2.15	.036
Lateral Position	.85	.12	.80	.13	1.53	.132
Lateral Position Variation	.28	.06	.26	.06	1.06	.292

Figure 2. Correlation coefficients between driving indexes and sleeping abnormalities in the control and MCI group



**** Presence of statistical significance P<.05***

DISCUSSION / CONCLUSION

- **The current findings indicate a stronger association between sleeping abnormalities and driving behavior in the MCI group as compared to the group of cognitively intact individuals**
- **In the MCI group, sleepiness was positively associated with lateral position variation and average speed, and negatively associated with average headway distance**
- **In the MCI group, insomnia symptoms were positively associated with lateral position variation, and negatively with the average wheel position**
- **The decreased cognitive capacities of drivers with MCI could potentially accelerate the influence of sleeping abnormalities on driving behavior**
- **Next steps: (a) evaluation of sleeping abnormalities on predicting driving performance with the use of multivariate models; (b) exploration of the capacity of sleeping abnormalities to predict driving performance during on-road driving conditions; (c) exploration of the association between sleeping abnormalities and driving behavior in other cognitive disorders**

SUMMARY

- **Sleeping abnormalities appear to reduce the driving capacity of older individuals.**
- **The association between sleeping abnormalities and driving behavior is stronger in the MCI group as compared to the control group**
- **Detecting predictors of driving behavior in the MCI group could increase our knowledge about the driving profile of the specific clinical group**

CONTACT INFORMATION

Corresponding author: Sokratis G. Papageorgiou, MD, PhD
2nd Department of Neurology, National University of Athens, University General Hospital 'ATTIKON', 1 Rimini Str, 12462 Haidari, Athens, Greece,
Phone: 0030-210-5832466, Email: sokpapa@med.uoa.gr

REFERENCES/ACKNOWLEDGEMENTS

- Frittelli, C., Borghetti, D., Iudice, G., Bonanni, E., Maestri, M., Tognoni, G., Pasquali, L., & Iudice, A (2009). Effects of Alzheimer's disease and mild cognitive impairment on driving ability: a controlled clinical study by simulated driving test. International Journal of Geriatric Psychiatry, 24, 232–238
- Kawano, N., Iwamoto, K., Ebe, K., Suzuki, Y., Hasegawa, J., Ukai, K., Umegaki, H., Iidaka, T., & Ozaki, N. (2012). Effects of mild cognitive impairment on driving performance in older drivers. Journal of the American Geriatrics Society, 60, 1379-1381.
- Vaz Fragoso, CA, Araujo KL, Van Ness PH, Marottoli RA. (2008). Prevalence of sleep disturbances in a cohort of older drivers. *J Gerontol A Biol Sci Med Sci, 63,* 715-723.
- Vaz Fragoso CA, Van Ness PH, Araujo KL, Iannone LP, Marottoli RA. (2013). Sleep disturbances and driving practices of older drivers. J Am Geriatr Soc, 61, 1730-1737.
- *This paper is based on two research projects implemented within the framework of the Operational Program "Education and Lifelong Learning" of the National Strategic Reference Framework (NSRF), namely the Research Funding Program: THALES. Investing in knowledge society through the European Social Fund, and the Action: ARISTEIA (Action's Beneficiary: General Secretariat for Research and Technology), co-financed by the European Union (European Social Fund – ESF) and Greek national funds.*